

ABSTRACT

A method of producing hot rolled steel having improved formability and minimal silver formation comprises the addition of Titanium and Boron to the molten steel to combine with and remove the free nitrogen prior to rolling. Titanium is added so that the amount of nitrogen remaining after Ti addition is about 0.0005 wt% to about 0.0025 wt% and Boron is added to remove the balance of the nitrogen by forming BN.

Copyright © 2000, American Iron and Steel Institute, Inc. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or by any information storage and retrieval system, without permission in writing from the American Iron and Steel Institute, Inc.

| Processing | Grade Type | LCAK | LCAK + Ti | LCAK + Ti | LCAK + Ti | LCAK + B | LCAK + Ti/B | Min / Max |
|------------------|-----------------------------|-----------------|-----------------|-----------------|-------------------|--------------------|-------------------|-----------|
| | Grade | CC040 | CC040B | CC041 | CC846EX | CC040F | | |
| | Coiling Temperature | 650 | 650 | 650 | 650 | 650 | 650 | |
| | Tension Leveling Elongation | 1% | 1% | 1% | 0.5% & 1.0% | 0.5% & 1.0% | 0.5% & 1.0% | |
| Chemistry | C | 0.041 ± 0.003 | 0.041 ± 0.004 | 0.041 ± 0.004 | 0.045 ± 0.002 | 0.042 ± 0.005 | | |
| | N | 0.0057 ± 0.0008 | 0.0038 ± 0.0007 | 0.0037 ± 0.0008 | 0.0044 ± 0.0003 | 0.0033 ± 0.0007 | | |
| | B | 0 | 0 | 0 | 0.0037 ± 0.0003 | 0.0018 ± 0.0002 | | |
| | Ti | 0.0012 ± 0.0005 | 0.018 ± 0.003 | 0.014 ± 0.003 | 0.0015 ± 0.0003 | 0.0058 ± 0.0020 | | |
| | N* | 0.0054 ± 0.0007 | 0 | 0 | 0.0039 ± 0.0004 | 0.0016 ± 0.0007 | -0.0002 / 0.0035 | |
| | BxN* | 0 | 0 | 0 | 1.46E-5 ± 0.24E-5 | 2.85 E-6 ± 1.27E-6 | -0.5E-6 / 6.4 E-6 | |
| | Stabilization Ratio | 0.085 ± 0.029 | 1.41 ± 0.31 | 1.12 ± 0.23 | 1.21 ± 0.09 | 1.28 ± 0.30 | 0.7 / 2.4 | |
| | Orientation | | | | | | | |
| | Count | 66 | 776 | 62 | 116 | 739 | 575 | |
| Yield Strength | Avg | 36.8 | 34.2 | 34.9 | 30.1 | 31.5 | 33.1 | |
| | Std Dev | 2.0 | 1.9 | 1.4 | 1.5 | 1.9 | 1.9 | |
| | Min | 32.8 | 28.1 | 31.0 | 26.2 | 26.4 | 28.4 | |
| | Max | 42.2 | 43.0 | 38.2 | 34.2 | 39.9 | 43.1 | |
| Tensile Strength | Avg | 52.2 | 50.1 | 50.4 | 48.2 | 48.2 | 48.3 | |
| | Std Dev | 1.4 | 1.3 | 0.9 | 1.1 | 1.4 | 1.4 | |
| | Min | 49.4 | 46.6 | 47.8 | 44.9 | 43.3 | 37.0 | |
| | Max | 57.0 | 61.1 | 53.0 | 50.9 | 52.5 | 53.9 | |
| Total Elongation | Avg | 40.8 | 43.2 | 43.1 | 43.7 | 43.5 | 41.5 | |
| | Std Dev | 2.7 | 2.7 | 2.5 | 2.6 | 2.5 | 2.9 | |
| | Min | 30.0 | 24.8 | 34.8 | 36.2 | 29.1 | 27.4 | |
| | Max | 46.5 | 50.8 | 48.0 | 50.6 | 53.2 | 50.3 | |
| n value | Avg | 0.198 | 0.208 | 0.206 | 0.208 | 0.201 | 0.200 | |
| | Std Dev | 0.013 | 0.010 | 0.009 | 0.009 | 0.012 | 0.009 | |
| | Min | 0.165 | 0.160 | 0.186 | 0.180 | 0.165 | 0.168 | |
| | Max | 0.230 | 0.243 | 0.226 | 0.225 | 0.263 | 0.223 | |
| Sliver Frequency | Average | 0.0 | 0.0 | 0.0 | 41.9 | 0.9 | | |
| | Std Dev | 0 | 0 | 0 | 28.2 | 2.2 | | |